4.1 GEOLOGICAL RESOURCES

This section discusses the potential geology impacts that may be associated with the proposed Project. The information presented below outlines the environmental setting, regulatory setting, significance criteria, the potential for impacts to the facilities from various geological events (earthquakes, slope instability, etc.), and the significance of these impacts. This section also presents discussions of impacts associated with alternatives to the proposed Project as well as projects identified in the cumulative projects analysis.

The geologic setting is described for the Ellwood Onshore Facility (EOF), the onshore portion of the pipeline/utility corridor to Platform Holly, the proposed pipeline from the EOF to Corral/Las Flores Canyon (LFC), and the Ellwood Marine Terminal (EMT). Line 96 is not discussed, since this pipeline would be abandoned in-place, resulting in no geologic impacts. Geologic impacts associated with Platform Holly have also not been discussed in this section. Ground disturbing activities are not proposed for Platform Holly; therefore, potential geologic impacts such as erosion, slope instability, and expansive soils have not been discussed in relation to the platform.

A 500-year seismic analysis was conducted for Platform Holly in 1996. The study results indicated that the platform, with minor repairs, would withstand a 500-year seismic event. The repairs were completed in 2004 and were formally approved by the California State Lands Commission (CSLC). At this time, it is not known what structural upgrades, if any, would be required to support the lease boundary extension. In conjunction with the preparation of this EIR, an assessment of the existing drilling platform jacket structure is being performed, including a seismic analysis, with CSLC oversight. After CSLC acceptance of findings, retrofit upgrade of the platform structure, if required, would be designed and submitted to CSLC for approval. Therefore, seismic related impacts related to Platform Holly have not been discussed in this EIR.

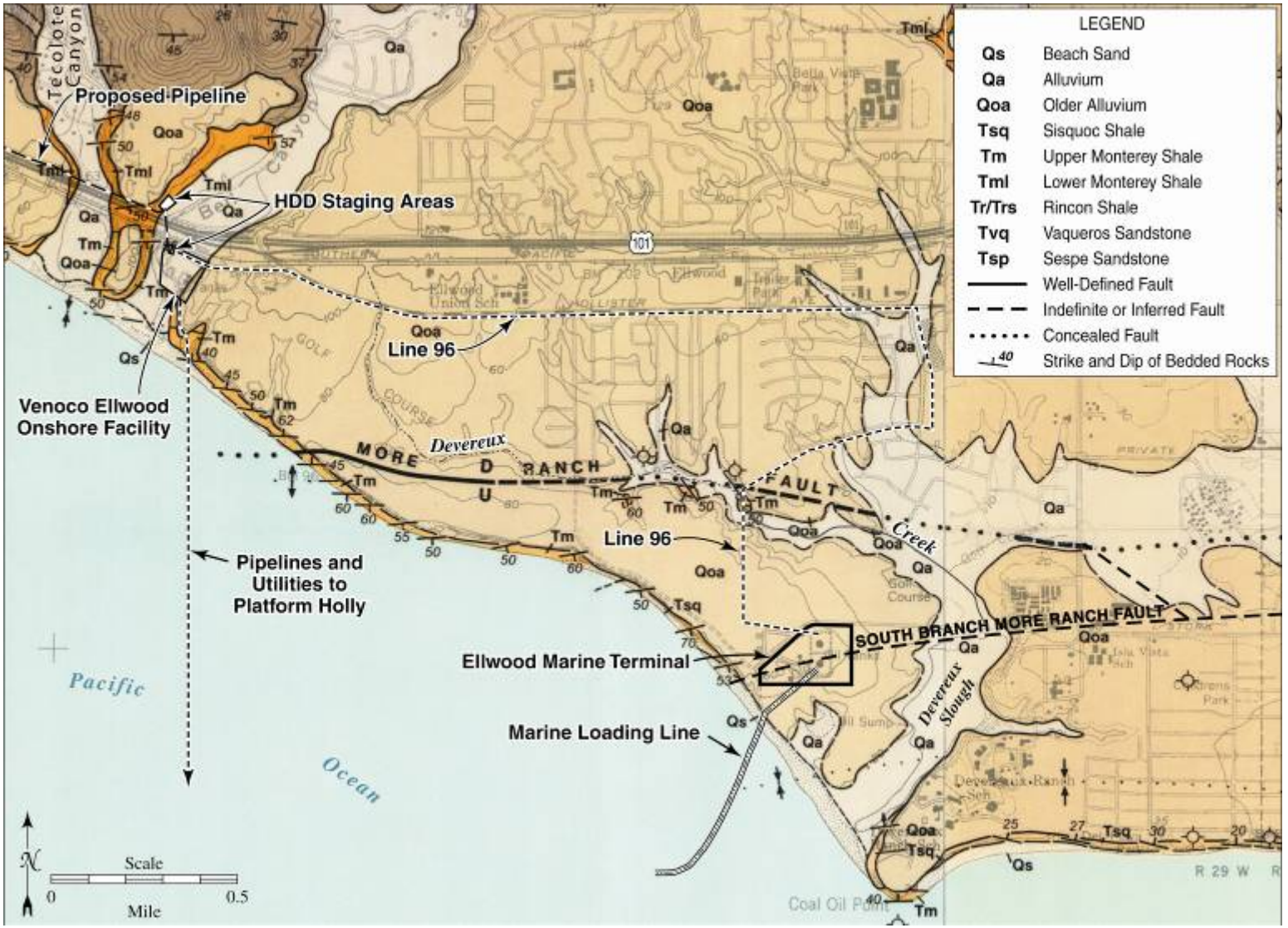
4.1.1 Environmental Setting

Physiography

Ellwood Onshore Facility

The EOF is located within Bell Canyon, approximately 800 feet (243.8 meters [m]) from the Pacific Ocean, at an elevation of approximately 20 feet (6.1 m) above mean sea level (Figure 4.1-1a). The southeast side of the canyon has been graded to create a level area on which the facilities are located.

Figure 4.1-1a
Geologic Map

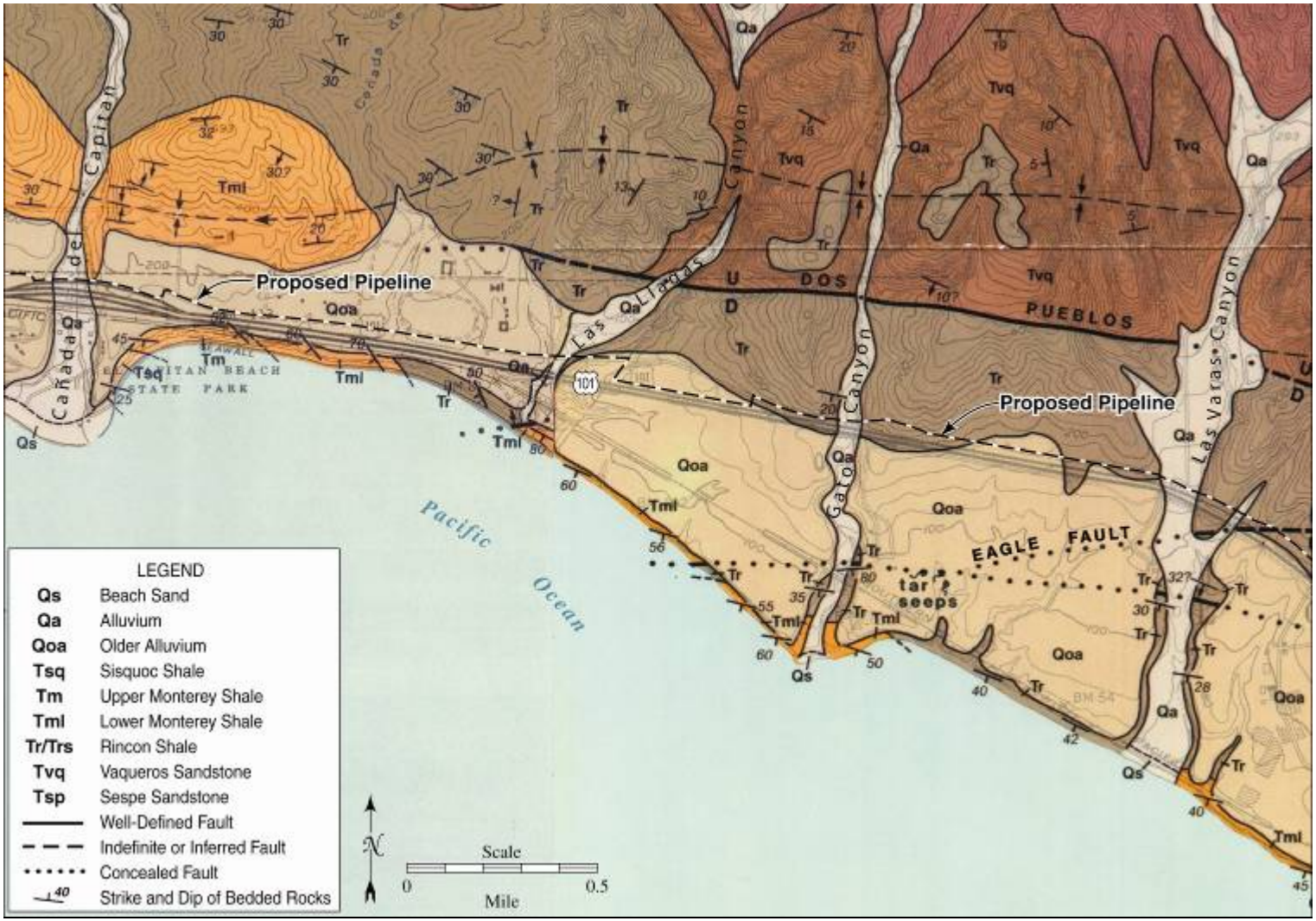


Source: Geology after Dibblee 1987a,b; Gurrola et al. 1998, 2003; Hoover 1985; Minor et al. 2002

Figure 4.1-1b
Geologic Map

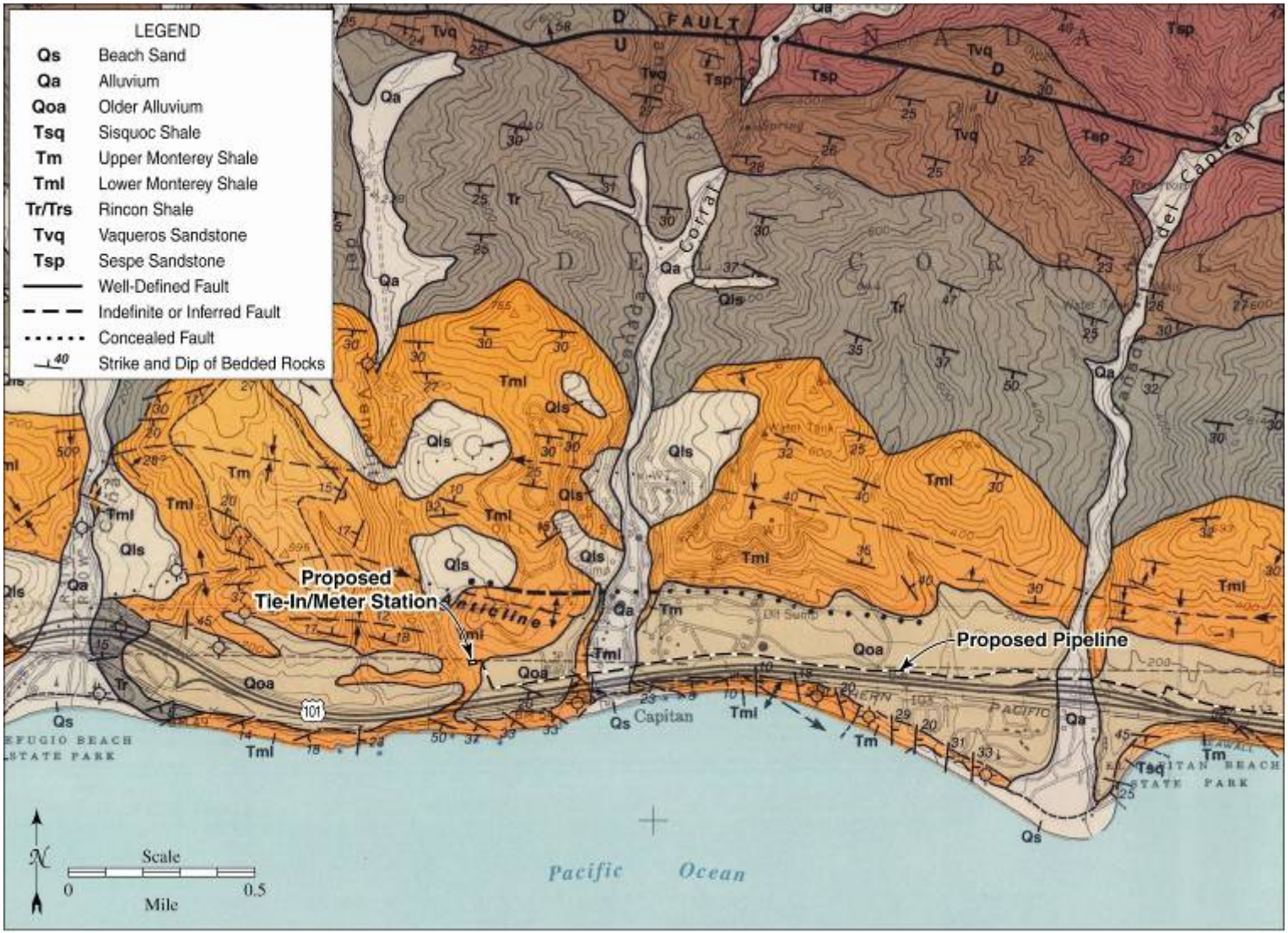
Source: Geology after Dibblee 1987a,b; Gurrola et al. 1998, 2003; Hoover 1985; Minor et al. 2002

Figure 4.1-1c
Geologic Map



Source: Geology after Dibblee 1987a,b; Gurrola et al. 1998, 2003; Hoover 1985; Minor et al. 2002

Figure 4.1-1d
Geologic Map



Source: Geology after Dibblee 1987a,b; Gurrola et al. 1998, 2003; Hoover 1985; Minor et al. 2002

Bell Creek is located immediately adjacent to the facility. A pipeline/utility corridor extends south from the EOF to the ocean, along a gently sloping roadway that traverses a low-lying terrace, then down a coastal bluff onto a relatively flat sandy beach.

Proposed Pipeline Route

The proposed pipeline traverses a coastal marine terrace, as well as along the base of adjoining east-west trending coastal foothills, at elevations ranging from 30 feet (9.1 m) to 250 feet (76.2 m) above mean sea level (Figures 4.1-1a through 4.1-1d). The proposed pipeline alignment traverses numerous north-south trending creeks and drainages. However, with the exception of localized steep creek banks and limited man-made embankments, such as immediately north of the EOF, where the alignment traverses the highway, the topography along the proposed alignment is gently to moderately sloped. Several of the larger canyon crossings, such as Eagle, Tecolote, and El Capitan canyons, are flat-bottomed with locally incised (i.e., vertical to near-vertical) creek banks.

Ellwood Marine Terminal

The onshore facilities of the EMT are situated on a coastal marine terrace, at an elevation of approximately 60 feet (18.3 m) above mean sea level (Figure 4.1-1a). These facilities are located approximately 500 feet (152.4 m) northeast of a coastal bluff, approximately 800 feet (243.8 m) northeast of the Pacific Ocean, and approximately 1,000 feet (304.8 m) northwest of Devereux Slough. The topography at the site has been partially graded, resulting in relatively flat-lying areas on which the storage tanks, pump house, control room, and related infrastructure are located. However, a northwest-trending gully, approximately 20 to 25 feet (6.1 to 7.6 m) deep, is located in the southwest portion of the site. An earthen-fill dam has been constructed across the upper portion of the gully, creating a pond upstream of the dam.

From the EMT, the onshore portion of the marine loading line traverses the southeast-sloping coastal marine terrace, across active coastal sand dunes blanketing the approximately 20 foot high (6.1 m) coastal bluff, and across a relatively flat beach area.

Stratigraphy

Ellwood Onshore Facility

The EOF is underlain by artificial fill, surficial soils, Quaternary alluvium, Miocene Monterey shale deposits, and beach sand. Surficial soils consist of the Milpitas-Positas-Concepcion association, which consists of moderately well-drained, fine sandy loams

on generally level terraces (U.S. Department of Agriculture, Soil Conservation Service 1981). Holocene alluvium, consisting primarily of unconsolidated floodplain deposits of silt, sand, and gravel, underlies the EOF, within the base of Bell Canyon (Dibblee 1987a). Both the surficial soils and alluvium have been graded to create a level building pad for the EOF, thus artificial fill deposits underlie much of the site.

A pipeline/utility corridor extends south from the EOF to the ocean, along a gently sloping roadway that traverses a low-lying terrace, underlain by the Miocene Monterey shale. These shale deposits vary from soft, fissile (i.e., easily eroded), silty, diatomaceous, clay shale to thin-bedded, hard, platy to brittle siliceous shale, and claystone (Dibblee 1987a). From this low-lying terrace, the pipeline/utility corridor traverses a relatively flat sandy beach.

Proposed Pipeline Route

The proposed pipeline route is underlain by artificial fill, surficial soils, Holocene alluvium, Pleistocene older alluvium, and Miocene shale deposits (Figures 4.1-1a to 4.1-1d). Because the proposed pipeline traverses Highway 101 and follows the frontage road along the north side of the highway, artificial fill is present along much of the alignment, where grading has been completed for highway and frontage road construction.

In areas previously not disturbed by grading, the upper few feet of strata consists of surficial soil deposits, including the Milpitas-Positas-Concepcion, Ayar-Diablo-Zaca, and Capitan-Linne associations. The Milpitas-Positas-Concepcion association, which occurs along the proposed pipeline alignment from Ellwood to Eagle canyons, consists of moderately well-drained, fine sandy loams on generally level terraces. The Ayar-Diablo-Zaca association, which occurs along the proposed pipeline alignment from Eagle Canyon to west of Gato Canyon, consists primarily of well-drained clays on gently- to moderately-sloping areas. The Capitan-Linne association, which occurs from west of Gato Canyon to the pipeline tie-in west of Corral Canyon, consists of well-drained, calcareous clay loams and cobbly clay loams on gentle- to moderately-sloping areas (U.S. Department of Agriculture, Soil Conservation Service 1981).

Holocene alluvium, consisting primarily of unconsolidated floodplain deposits of silt, sand, and gravel, is present in all the major canyon bottoms along the pipeline alignment, including Bell, Tecolote, Eagle, Dos Pueblos, Las Varas, Gato, Las Llagas, El Capitan, and Corral canyons. Pleistocene older alluvium deposits, consisting primarily of partially consolidated to unconsolidated silt, sand, and gravel, form a relatively thin veneer,

approximately five to 20 feet (1.5 m to 6.1 m) thick, over the gently-sloping coastal marine terrace (Dibblee 1987a, 1988).

The older alluvium deposits overlie the Miocene Monterey and Rincon shale formations. These shale deposits vary from soft, fissile (i.e., easily eroded) silty, diatomaceous, clay shale to thin-bedded, hard, platy to brittle siliceous shale and claystone. Much of the proposed pipeline alignment, from Eagle Canyon to Las Llagas Canyon, is located along the northern edge of the coastal terrace, at the transition from the older alluvium to Rincon shale deposits. Where present, the older alluvium deposits are relatively thin (i.e., approximately one to six feet [0.3 to 1.8 m] thick) along this portion of the pipeline alignment. Where the older alluvium is absent, the pipeline alignment is located directly above the Rincon shale deposits (Dibblee 1987a, 1988).

In the eastern and western portions of the proposed pipeline alignment, such as from Bell Canyon to Eagle Canyon, as well as from Las Llagas Canyon to the pipeline tie-in west of Corral Canyon, the pipeline route traverses the central portion of the marine terrace, where the older alluvium is thicker (approximately six to 20 feet (1.8 m to 6.1 m) than along the margins of the coastal plain. These areas are underlain by both the Monterey and Rincon shale formations (Dibblee 1987a, 1988).

The Monterey Formation occurs primarily in the eastern and western portions of the pipeline route, in the vicinity of Bell and Eagle canyons to the east and El Capitan and Corral canyons to the west. The Monterey Formation consists of an upper, thin-bedded, hard, platy to brittle shale unit and a lower, soft, erodible unit with interbeds of hard shale and limestone (Dibblee 1987a, 1988).

The Rincon Formation, which occurs in the central portion of the pipeline route, from east of Eagle Canyon to east of El Capitan Canyon, consists primarily of poorly-bedded clay shale and claystone (Dibblee 1987a, 1988).

Ellwood Marine Terminal

The EMT is underlain by the Milpitas-Positas-Concepcion soils association, which consists of moderately well-drained, fine sandy loams on generally level terraces (U.S. Department of Agriculture, Soil Conservation Service 1981). Underlying these surficial soil deposits is Pleistocene older alluvium, consisting primarily of relatively unconsolidated silt, sand, and gravel. These alluvial deposits overlie the Miocene Sisquoc Formation, which is exposed in the coastal bluff northwest of the Project area and consists of silty, diatomaceous, clay shale (Figure 4.1-1a). The majority of the

onshore portion of the marine loading line similarly traverses older alluvium, underlain by Sisquoc Formation; however, the seaward 200 feet (61 m) of the pipeline is underlain by beach sand deposits (Dibblee 1987a).

Beach Scour

Beach scour as discussed in this section is defined as the removal of soil particles caused by concentrated surface water flow, in gullies or creeks, or by wave action along the oceanfront. Surficial soils across most of the site consist of artificial fill and the Concepcion series soils, which are moderately well-drained soils on low terraces that parallel the coastline. Artificial fill, consisting of a mixture of Concepcion series soils and underlying older alluvium deposits, is present in areas where the onshore site has been graded. Undisturbed areas are comprised of Concepcion series soils, which formed in mixed alluvium and consist primarily of grayish brown, fine sandy loam, approximately 19 inches (48 centimeters [cm]) thick.

The seaward portion of the pipelines and utilities, which extend from Platform Holly to the EOF, traverses relatively loose beach sand, which is generally prone to erosion and scour. Sands in the intertidal area are generally scoured off the beach during the winter months as a result of high surf activity, but then generally accrue during the summer months of gentle surf. Successive strong winter storm surf events as occurred in 1978, 1983, 1996, 1998, and 2006, have periodically exposed the pipeline in the intertidal zone. For example, photographs and daily pipeline inspection logs on file at the Santa Barbara County Energy Division, illustrate that up to 20 feet (6.1 m) of the oil line was exposed, including almost 20 feet of free-span (unsupported pipeline), from January 3, 2006, to January 23, 2006. Similarly, approximately 50 feet (15.2 m) of the gas line was exposed from January 3, 2006, to January 4, 2006. These records illustrate that the length of the exposure fluctuated daily as a result of fluctuating sand scour and subsequent accrual.

Existing onshore facilities at the EMT are located on gentle slopes, i.e., zero to two percent slopes, where runoff is slow and the hazard of erosion and scour is slight. However, the marine loading line traverses a short segment with moderately steep, eroded slopes, up to 30 percent, where runoff is medium to rapid and the hazard of erosion and scour is moderate to very high (USDA 1981). However, the majority of the marine loading line route is well vegetated, thus substantially reducing the potential for erosion and scour under existing conditions.

The seaward portion of the marine loading line traverses relatively loose dune and beach sand, which is generally prone to erosion and scour. Sands in the intertidal area

are generally scoured off the beach during the winter months as a result of high surf activity, but then generally accrue during the summer months of gentle surf. Successive strong winter storm surf events have periodically exposed the pipeline in the intertidal zone. For example, photographs and letters from Mr. David Sangster and Storrer Environmental, Inc., on file at the Santa Barbara County Energy Division illustrate that in February 1998, wave scour eroded the beach sand and sand dunes in the vicinity of the loading line, creating a 10- to 12-foot (3- to 3.5-m) vertical beach scarp along the sand dunes, which resulted in a section of pipe approximately 40 to 55 feet (12 to 16 m) in length becoming unsupported. These records illustrate that the length of the free span fluctuated daily as a result of fluctuating sand scour and subsequent accrual. In addition, photographs of the exposed pipeline and adjacent pipeline markers indicate that, as a result of erosive beach scour, the portion of the pipeline within the intertidal zone subsided approximately three feet (1 m) from February 1996 to February 1998.

Slope Stability

Ellwood Onshore Facility

The EOF is located in the base of Bell Canyon, on a graded, relatively flat building pad. No landslides have been mapped on the northwest-facing hillside, located immediately adjacent to the facility (Dibblee 1987a). The pipeline/utility corridor to Platform Holly traverses a low-lying, gently-sloping terrace before extending down a moderately-sloped coastal bluff, approximately 20 feet (6.1 m) high, onto the gently-sloping beach.

Proposed Pipeline Route

With the exception of localized steep creek banks and limited man-made embankments, such as immediately north of the EOF, where the alignment traverses the highway, the topography along the proposed alignment is gently to moderately sloped. Several of the larger canyon crossings, such as Eagle, Tecolote, and El Capitan canyons, are flat-bottomed with locally incised (i.e., vertical to near-vertical) creek banks. No landslides have been mapped along the pipeline route (Dibblee 1987a, 1988), and other than possible shallow slumping along incised creek banks, no areas of potential slope instability or soil creep were observed by SAIC staff during site reconnaissance as part of the analysis for the preparation of this environmental document.

Ellwood Marine Terminal

The topography at the EMT is relatively flat with gentle rolling slopes; therefore, the potential for slope instability is low. Similarly, the topography along the majority of the marine loading line is relatively flat to gently sloping where it traverses the coastal marine terrace. The northern portion of the pipeline route traverses a northwest-trending gully, approximately 20 to 25 feet (6.1 to 7.6 m) deep, which consists of a steep northeast flank and gently sloping southwest flank. These slopes are very well vegetated and consist of massive, non-bedded, older alluvium deposits, with no evidence of prior slope instability. Therefore, the potential for slope instability under existing conditions is low. The loading line traverses a gently to moderately sloping coastal bluff, covered with well-vegetated, active sand dunes. The moderate gradient and abundant vegetation similarly creates limited potential slope instability under existing conditions.

Expansive Soils

Expansive soils are clay-rich soils that tend to swell when the moisture content increases and shrink when the moisture decreases. The volume changes resulting from variable moisture conditions can cause movement and cracking of overlying structures. As discussed above, surficial soils (primarily overlying the Rincon Formation), from Eagle Canyon to the pipeline tie-in location west of Corral Canyon, are clay-rich and therefore have a moderate to high soil expansion potential. However, canyon bottom soils generally have a low soil expansion potential (County of Santa Barbara 1979).

Faulting And Seismicity

Regional Seismicity

The Goleta/Gaviota area is located in the Western Transverse Ranges, a seismically active region of southern California. This area has experienced numerous seismic events over the last two centuries, including a few historic large-scale (magnitude greater than 6.0) events, such as the 1812 earthquake, which had a probable Richter magnitude of 7.0/7.1 and likely occurred either offshore on the North Channel Slope; on an underlying blind thrust fault; on the San Cayetano, Oak Ridge, or Pitas Point faults to the east; or on the Santa Ynez River Fault to the northwest (Toppozada et al. 1981; Dolan and Rockwell 2001; Gurrola et al. 2003). Other destructive earthquakes struck the Santa Barbara/Goleta area in 1857 (San Andreas Fault, magnitude 8.4), in 1925 (Santa Barbara vicinity, possibly the More Ranch or Mesa fault, magnitude 6.3), in 1927

(offshore Point Arguello, magnitude 7.3), and in 1978 (offshore North Channel Fault, magnitude 5.9).

Regional onshore faults that can be expected to cause seismic shaking in the Project area during an earthquake include the San Andreas Fault, located approximately 52 miles (83 kilometers [km]) from the Project area, and the Santa Ynez/Santa Ynez River Fault Zone, located approximately six miles (9.7 km) from the Project area, at the closest point. Both of these faults are considered active (Dibblee 1966; Jennings 1994; CDMG 1999). The San Cayetano blind thrust fault, located approximately six to seven miles (9.7 to 11.3 km) beneath the Project area, poses another significant seismic hazard (Namson and Davis 1988, 1990). The offshore Pitas Point/North Channel and Red Mountain faults, located approximately five miles (eight km) and 16 miles (25.7 km) offshore, respectively (Jennings 1994), are also considered active and would cause seismic shaking in the Project area during an earthquake (Foxall et al. 1995). In addition, the Oak Ridge and Channel Islands faults pose significant offshore seismic sources (Shaw and Suppe 1994; Sorlein et al. 2000).

North Branch More Ranch Fault

The More Ranch Fault Zone traverses the EMT area and possibly extends offshore across the pipeline/utility corridor from Platform Holly to the EOF. This fault zone consists of the South, Central, and Northern branches of the More Ranch Fault (a south-dipping reverse fault), which elevated the marine terrace on the Ellwood Mesa from the Goleta Valley to the north. These faults are visible in the sea cliffs and, in the case of the North Branch More Ranch Fault, have clear geomorphic expression. The North Branch More Ranch Fault was mapped by Dibblee (1987a, b) and Gurrola et al. (1998, 2003) as trending approximately 0.4 mile (0.6 km) north of the EMT site and 0.5 mile (0.8 km) southeast of the EOF and proposed pipeline, at the closest point (Figure 4.1-1a). Dibblee (1966, 1987b) indicates displacement of both recent, i.e., Holocene, and older, i.e., Pleistocene, alluvial deposits along the North Branch More Ranch Fault. Holocene movement of this fault is suggested by north-facing fault scarps that are present on the east and west ends of this nine mile long (14.5 km) fault. The uplifted coastal mesas (Ellwood, Devereux, Isla Vista, University, and More Mesa) occur to the south of this fault as a result of fault movement.

The California Geological Survey (formerly the California Division of Mines and Geology [CDMG]) defines active faults as those along which movement has occurred within Holocene time (approximately the last 11,000 years). Potentially active faults display evidence of movement during Quaternary time (the past 1.6 million years). Inactive

faults demonstrate no evidence of movement within Quaternary time (CDMG 1994). The Santa Barbara County General Plan Safety Element considers the More Ranch Fault(s) to be active. However, this fault zone has not been zoned as an active fault by the State of California (Jennings 1994; CDMG 1999). Based on sea cliff exposures, geomorphic expression, and oil well data, the North Branch More Ranch Fault is likely the most active structure in the More Ranch Fault System. Based on mapping by Gurrola (2003), the fault locally warps, folds, and faults a 45,000-year-old marine terrace platform and overlying alluvial sediments from Ellwood to More Mesa; therefore, Gurrola considers the fault potentially active.

The maximum projected earthquake magnitude of an earthquake along an active or potentially active fault may be calculated as a function of the total fault length or as a function of the fault surface area (Wells and Coppersmith 1994). Geologists have estimated a moment magnitude, i.e., a maximum expected earthquake, of magnitude 6.4 (Gurrola and Keller 1999) and a maximum credible earthquake of magnitude 6.8 (Hoover and Associates 1985). However, Gurrola et al. (2003) consider the More Ranch Fault as part of an extended fault system that includes the Mission Ridge-Arroyo Parida Fault System, which has a length of approximately 42 miles (70 km). Given a rupture length of 42 miles (67.6 km), the More Ranch-Mission Ridge-Arroyo Parida Fault System is capable of generating a maximum credible earthquake magnitude of approximately 7.0 or greater (Gurrola et al. 2003).

The amount of seismically induced ground shaking is measured as ground acceleration, which is a function of earthquake magnitude, distance from the earthquake source, and rock and soil types present on the site, measured in percent of gravity (g). Some geologists have suggested that the More Ranch Fault could generate a peak bedrock acceleration of 0.80 g (Santa Barbara County 1997). A larger magnitude earthquake on an offsite fault would generate ground accelerations of approximately 0.75 g, as a function of distance from the Project site (Hoover and Associates 1985). However, others have suggested a peak ground acceleration in the vicinity of the Project site of 0.6 g, although higher peak accelerations can be generated locally (Mualchin 1996).

South Branch More Ranch Fault

The South Branch More Ranch Fault traverses the vicinity of the EMT site, approximately 1.8 mile (2.9 km) southeast of the EOF and proposed pipeline, and possibly extends offshore across the pipeline/utility corridor from Platform Holly to the EOF (Figure 4.1-1a) (Gurrola et al. 1998, 2003; Minor et al. 2002). The exact location of this fault across the EMT is not well defined because its estimated location is based

primarily on a review of 1928 aerial photographs; however, the fault offsets by up to 15 feet (4.6 m) a 45,000-year-old marine terrace on University of California, Santa Barbara property, west of Storke Road, as well as on the nearby sea cliff, and is therefore considered potentially active (Fugro West 2003; Gurrola et al. 2003).

Central Branch More Ranch Fault

Fault strands located between the North and South branches of the More Ranch Fault Zone have been designated by some geologists as the Central Branch More Ranch Fault. The state of activity of this branch is unknown, but the basal terrace deposits are offset by the fault on the Ellwood Mesa, suggesting that the Central Branch fault is also potentially active. However, Fugro West has identified short, discontinuous, potentially active faults approximately 500 feet (152.4 m) northwest of the EMT site and 1.8 mile (2.9 km) southeast of the proposed pipeline, at the closest point. Fugro West does not recognize these fault strands as part of the Central Branch More Ranch Fault (Fugro West 1996, 2003; County of Santa Barbara 2004; UCSB 2004).

Liquefaction

Liquefaction is a type of ground failure that occurs as a result of loss of shear strength or shearing resistance in loose and sometimes medium dense, cohesionless soils, due to seismically induced ground shaking. Liquefaction typically occurs in sediments where ground water is less than 50 feet (15.2 m) below ground surface. The county of Santa Barbara identifies the EOF and proposed pipeline route as having a low liquefaction potential within the base of alluvial filled Bell, Tecolote, and El Capitan canyons, as well as at the EMT site (County of Santa Barbara 1979). If liquefaction were to occur within the Project area, these low-lying sandy areas would be the most likely to experience this phenomenon due to generally sandy soils and shallow groundwater.

Other Types of Seismic Ground Failure

Differential settlement is a process whereby soils settle non-uniformly, potentially resulting in stress and damage to pipelines or other overlying structures. Such movement can occur in the absence of seismically induced ground failure, due to improper grading and soil compaction or discontinuity of naturally occurring soils; however, strong ground shaking often greatly exacerbates soil conditions already potentially prone to differential settlement, resulting in distress to overlying structures. Elongated structures, such as pipelines, are especially prone to damage as a result of differential settlement.

Lateral spreading is a type of seismically induced ground failure that occurs when cracks and fissures form on an unsupported slope, resulting in lateral propagation and failure of slope material in a downslope direction. This type of failure is common in unconsolidated river or stream bank deposits, where lateral stream scour creates oversteepened banks in unconsolidated silts and sands.

Natural Oil Seeps

Prolific natural hydrocarbon seepage occurs offshore of Coal Oil Point in the Santa Barbara Channel, California. The seeps emit both liquid and gaseous hydrocarbon phases, with gas predominating. The most active gas seeps form visible boils where intersecting the sea surface. Such hydrocarbon seepage affects ocean chemistry and provides a natural source of petroleum pollution. Submarine venting of methane, a greenhouse gas, may provide a substantial and overlooked source of methane in the environment. At a regional scale, the Coal Oil Point seeps represent a significant source of gaseous hydrocarbons and residual asphaltic hydrocarbons, or beach tar. Chemical analysis of air grab samples collected from airplanes over the Santa Barbara Channel suggests that geogenic sources of hydrocarbon trace gases, (i.e., natural seeps) dominate over anthropogenic sources (i.e., automobile emissions) and that 86 percent of the non-methane hydrocarbons in these samples originated from natural seeps. In 1990, the emission rates from the Coal Oil Point seeps were equal to twice the emission rate from all the on-road vehicle traffic in the county. The natural hydrocarbon seeps in the Santa Barbara Channel are also the principle source of dissolved methane in the California Current (Quigley, et al., 1999; Hornafius et al. 1999).

The Miocene diatomaceous shale and siltstone of the Monterey Formation are the source for the seep emissions. The nearshore seeps at Coal Oil Point are predominantly oil exuded directly from the outcrop of the Monterey Formation. Further offshore, seepage passes through overlying Sisquoc Formation cap rock and includes both oil and gas. The offshore seepage is controlled by the local west-northwest trending geologic structure. Seepage is most intense at submarine fault conduits and at structural closures along anticline axes (Quigley, et al., 1999; Hornafius et al. 1999).

Offshore oil production occurs at Platform Holly at one structural closure along the South Ellwood anticline, and has been a site of intense historical seepage. At a second closure, one mile (1.5 km) east of Platform Holly, prolific gaseous seepage is captured by a pair of seep tents, which consist of steel pyramids covering 20,000 square feet (1,900 square meters). The aerial distribution and volume of seep emissions have

varied. Time variation in the seep emissions is an important issue, as it implies variability in the local background levels against which pollution from industrial activities are measured. A time series of average monthly seep gas emission volumes collected at the seep tents illustrates the variability in the seep emissions. Some variations in seepage could result from natural effects (e.g., changes in the fracture migration pathways due to viscous tar sealing) or seismic activity. However, these effects likely only account for second-order variations. The dominant trend is most likely attributable to the effect of oil production on the reservoir pressure that drives seepage. The disappearance of seepage around Platform Holly, and the decline in emission volumes collected at the adjacent seep tents, indicates a long-term decline in seepage. That the observed reductions in seepage are spatially associated with oil production from Platform Holly, suggests that decline in seepage between 1973 and 1995 is associated with effects of oil production (Quigley, et al., 1999; Hornafius et al. 1999).

A net increase in production from the reservoirs, (increased crude and gas production above increased water and/or gas injection), according to the studies discussed above, would most likely be associated with a net decrease in seep flows, although some uncertainty exists. Historical production from Platform Holly is summarized below by reservoir pool, oil and water production and water injection.

Table 4.1-2
Ellwood Area Production and Injection, 2006

Reservoir/Pool	Prod Oil, bbls	Prod Water, bbls	Inj Water, bbls
Rincon	9,213	82,170	0
Monterey	1,099,557	3,932,124	0
Sisquoc	1,349	0	0
Sisquoc-Monterey	0	0	1,686,996
Vaqueros	0	0	2,349,041
	1,110,119	4,014,294	4,036,037

Source: DOGGR Production and Injection databases online at www.conservation.ca.gov.

Over 99% of the oil produced from the South Ellwood Field at Platform Holly has been from the Monterey formation. Historically, the water produced from the Monterey formation has been injected back into the Vaqueros formation in the Ellwood Field from the onshore injection well and into the Sisquoc/Monterey formation in the South Ellwood Field from injection wells on Platform Holly. This has produced a net outflow of fluids from the Monterey formation.

A report jointly developed by Santa Barbara County and the USGS (SBC 2004) indicates that "*samples of oil produced at Platform Holly (offshore of Coal Oil Point) and Platform "A" (in the eastern Santa Barbara Channel) are very similar to much of the oil found on Santa Barbara's southern beaches. The biomarker method so far has been unable to distinguish these oils*". Quigley (1999) indicates that "*The Miocene diatomaceous shale and siltstone of the Monterey Formation are the source for the seep emissions*". Quigley also states that "*declines in reservoir pressure and depletion of seep hydrocarbon sources associated with oil production are the mechanisms inferred to explain the declines in seep area and emission volume*".

Sampling and geochemical analysis of beach tar balls and oil from offshore drilling platforms have been completed along the coast from Santa Barbara north to Point Sal (Lorenson, et al., 2004). It was concluded that it was impossible to conclusively differentiate samples collected from natural seepage from Platform Holly oils, which have biomarker parameters that are similar to seep oils. In contrast, all of the platform oil samples collected from offshore Point Arguello, including Harvest, Hermosa, Hidalgo, and Irene, demonstrated higher thermal maturity than tar balls collected on Surf Beach. Higher thermal maturity would be expected from production oils that are pumped from deeper levels and have experienced more thermal maturation. All beached tar balls share geochemical characteristics typical of source rock in the near-surface Monterey Formation, which contains heavy, low-grade petroleum that formed under low thermal maturity conditions.

4.1.2 Regulatory Setting

Federal

The Uniform Building Code (UBC) defines different regions of the United States and ranks them according to their seismic hazard potential. There are four categories of these regions, designated as Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest seismic potential. The Project area is located within Seismic Zone 4; accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4.

State

California Building Code

The CSLC issues and administers oil and gas leases covering tide and submerged lands in accordance with the provisions of Division 6, Parts 1 and 2 of the California

Public Resources Code (PRC) and pursuant to the regulations set out in Title 2, Division 3 of the California Code of Regulations (CCR). The PRC Section 6829 includes provisions for specifying methods of operation and standard requirements for conducting operations properly; the prevention of waste, the protection of the safety and health of the workers; and the liability of the lessee for personal injuries and property damage. The PRC Section 6829.2 includes provisions for the possible arresting or amelioration of land subsidence. The PRC Section 6873.2 and Section 6873.5 include provisions for carrying out the requirements of the CEQA.

Articles 3 thru 3.4 of Title 2, Division 3 of the CCR provide regulations covering oil and gas leasing and operating requirements, oil and gas drilling and production regulations, and pollution control for leases located on State tide and submerged lands under the jurisdiction of the CSLC. The CSLC regulations are applicable to operations conducted from mobile rigs, fixed offshore structures and upland locations serving these leases. Provisions in these articles include protection of human health, regulations on wellhead equipment, subsurface safety valves, surface safety valves, remedial and well maintenance work, supervision and training, anomalous casing annulus pressure, subsurface injection, conversion of a well to fluid injection, waste disposal, pressure relief valves, personal protective equipment, and pipeline inspections.

Article 3.6 of Title 2, Division 3 of the CCR includes requirements for operators to prepare an operations manual describing equipment and procedures, which the operator employs or will employ to protect public health and safety and the environment. This article also includes provisions for development and maintenance of emergency response plans that include natural disaster response planning.

The State of California provides a minimum standard for building design through the California Building Code (CBC), which is based on the UBC, but has been modified for California conditions. The CBC is selectively adopted by local jurisdictions, based on local conditions. The Project area is also located within Seismic Zone 4 of the CBC (County of Santa Barbara 1979).

Chapter 16 of the CBC contains specific requirements for seismic safety. Chapter 18 of the CBC regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational

safety standards for excavation, shoring, and trenching, as specified in the State of California Division of Occupational Safety and Health (commonly called Cal/OSHA) regulations (Title 8 of the CCR) and in section A33 of the CBC.

The Alquist-Priolo Special Studies Zones Act of 1972

The criteria most commonly used to estimate fault activity in California are described in this act, which addresses only surface fault-rupture hazards. The legislative guidelines to determine fault activity status are based on the age of the youngest geologic unit offset by the fault. An active fault is described by the CDMG as a fault that has "had surface displacement within Holocene time (about the last 11,000 years)." A potentially active fault is defined as "any fault that showed evidence of surface displacement during Quaternary time (last 1.6 million years)." This legislation prohibits the construction of buildings used for human occupancy on active and potentially active surface faults. However, only those potentially active faults that have a relatively high potential for ground rupture are identified as fault zones. Therefore, not all potentially active faults are zoned under the Alquist-Priolo Earthquake Fault Zone, as designated by the State of California.

The Seismic Hazards Mapping Act

These regulations were promulgated for the purpose of promoting public safety by protecting against the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. Special Publication 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California" (CDMG 1997), constitutes the guidelines for evaluating seismic hazards other than surface fault-rupture, and for recommending mitigation measures as required by PRC Section 2695(a). However, to date the California Geological Survey (CGS) has not zoned offshore California under the Seismic Hazard Mapping Act. Therefore, this act does not apply to this Project.

California Coastal Act

The California Coastal Air Act (Coastal Act) of 1976 created the California Coastal Commission (CCC) and six area offices, which are charged with the responsibility of granting development permits for coastal projects and for determining consistency between Federal actions and State coastal management programs. Also in 1976, the State legislature created the California State Coastal Conservancy to take steps to preserve, enhance, and restore coastal resources and to address issues that regulation alone cannot resolve. The Coastal Act created a unique partnership between the State (acting through the CCC) and local government to manage the conservation and

development of coastal resources through a comprehensive planning and regulatory program. The CCC uses the Coastal Act policies as standards in its coastal development permit decisions and for the review of local coastal programs, which are prepared by local governments. Among many issues, the local coastal programs require protection against loss of life and property from coastal hazards, including geologic hazards. This requirement is implemented locally through the Santa Barbara County Comprehensive Plan, Seismic Safety and Safety Element.

Local

Conformance with the County of Santa Barbara's Grading and Building Codes are considered generally satisfactory (by the county), with respect to geologic hazards; however, select amendments are recommended in the County General Plan Seismic Safety and Safety Element (County of Santa Barbara 1979). This document recommends that an adequate site-specific investigation be performed where the possibility of soil or geologic problems exist.

4.1.3 Significance Criteria

Impacts are considered significant if any of the following conditions apply:

- Settlement of the soil, soil expansion, or slope instability that could substantially damage structural components of the pipeline;
- Deterioration of structural components of the pipeline due to corrosion, weathering, fatigue, or erosion that could reduce structural stability;
- Erosion induced siltation of nearby waterways as a result of ground disturbing activities;
- Ground motion due to a seismic event that could induce liquefaction, differential settlement, or lateral spreading that could damage structural components; or
- Damage to petroleum pipelines and/or valves along the pipeways from any of the above conditions that could release crude oil into the environment.

4.1.4 Impact Analysis and Mitigation

The proposed Project is expected to have a less than significant impact in association with slope stability. The proposed pipeline would not traverse any steep slopes that

might be subject to failure. Localized steep creek banks would be avoided, as horizontal directional drilling (HDD) would be utilized to drill beneath the creeks where such steep slopes are present. Therefore, the integrity of the pipeline would not be compromised as a result of slope instability during Project construction or operation.

Geologic impacts of the proposed Project are primarily associated with potential facilities failure resulting from an earthquake, corrosion, expansive soils, or beach scour. Pipeline construction and replacement activities, which would be needed for maintaining the pipeline and related facilities, could result in erosion induced siltation of nearby creeks and drainages. Similarly, remediation of possible pipeline oil spills, as well as remediation of contaminated soils during EMT abandonment, would result in soil disturbance and potential erosion induced sedimentation of local creeks and drainages.

The following describes these geologic impacts associated with the proposed Project.

Impact GEO-1: Slope Failures

Ground-disturbing pipeline construction, pipeline replacement activities, EMT abandonment activities, and/or oil spill remediation may cause localized sloughing of unconsolidated alluvial sands and artificial fill (Less than Significant, Class III).

Impact Discussion

The proposed pipeline would be constructed primarily on gently to moderately sloping topography. No steep slopes that would be likely to result in slope instability during pipeline trenching activities, or during subsequent pipeline operations, are present along the proposed alignment. Localized steep creek banks, such as those present in Eagle and Dos Pueblos creeks, would be avoided, as HDD would be utilized to drill beneath those creeks. Similarly, steep highway embankments, located immediately north of the EOF, would be avoided by HDD beneath these slopes and the highway. Therefore, the integrity of the pipeline would not be compromised as a result of gross slope instability during Project construction or operation.

Excavations completed for new pipeline construction, pipeline replacement activities, or soil remediation at the EMT would result in vegetation removal and creation of temporary steep slopes. Such activities could result in sloughing of unconsolidated alluvium, beach sands, and/or artificial fill deposits. However, sloughing would likely be shallow and localized, and would likely not affect the integrity of the pipeline or other infrastructure.

Mitigation Measures

As potential slope stability impacts on geological resources would be less than significant, no mitigation is required.

Impact GEO-2: Damage to Facilities Due to Beach Scour

Beach scour could substantially damage structural components of the EOF (Potentially Significant, Class II).

Impact Discussion

Successive strong winter storm surf events, such as those in 1978, 1983, 1996, 1998, and 2006, have periodically exposed the EOF pipelines in the intertidal zone and resulted in pipeline fee-spans, or unsupported sections of pipeline. Based on calculations by the Santa Barbara County Building and Safety Division, the marine loading line at the EMT is vulnerable to damage if the free span distance exceeds 30 feet (9.1 m). Venoco has completed similar calculations for the EOF intertidal pipelines. For Long Term, the Maximum Unsupported Spans in Air are: 64 feet for the six-inch Oil Emulsion Pipeline; 83 feet for the six-inch Gas Pipeline; 68 feet for the four-inch Utility Line; and 74 feet for the eight-inch Seep Tent Gas Pipeline. In the future, pipeline free-spans and scour-induced pipeline settlement could result in structural damage and rupture of the pipeline. Therefore, potential impacts due to wave scour would be *potentially significant*, but can be mitigated to *less than significant* levels with implementation of Mitigation Measure **(MM) HM-3b**.

The Applicant's EOF Permit conditions number 63 and 64, include the following with respect to pipeline inspection in the surf zone.

> *63. The oil emulsion and gas pipelines shall be visually inspected from the surf zone to the EOF on a daily basis for as long as they are in operation. At a minimum, the following information shall be logged for all inspections: time and date of the inspection; inspector's name; burial status of the pipelines; length of pipe exposed, if any; estimated wave height at the surf; any evidence of pipeline movement. Log reports shall be maintained at the EOF and made available to the County for inspection upon request.*

> *64. Venoco shall shut down and displace the emulsion line with seawater during large storms events (defined as waves measuring more than 12 feet in height) when*

more than 20 feet of the pipeline is exposed. Venoco shall notify P&D of the need to shut down the line immediately upon doing so.

Mitigation Measure

Implement **MM HM-3b**, which requires the replacement of the beach portions of the emulsion pipeline with pipeline installed through horizontal directional drilling extending to a location beyond the tidal areas that could be affected by wave action.

Rationale for Mitigation

The replacement of the beach segment of the pipeline with an HDD segment, as per **HM-3b**, would eliminate the potential for beach scour.

Impact GEO-3: Erosion of Drainages

Ground-disturbing pipeline construction, pipeline replacement activities, EMT demolition, and/or oil spill remediation could result in increased erosion and sedimentation of local drainages (Potentially Significant, Class II).

Impact Discussion

Pipeline construction, routine maintenance, pipeline replacement, and/or oil spill remediation activities would result in vegetation removal and excavations, which may cause an increased potential for short-term erosion and sedimentation of several creeks, including Bell, Tecolote, Eagle, Dos Pueblos, Las Varas, Gato, Las Llagas, El Capitan, and Corral/Las Flores creeks. Bell, Eagle, and Dos Pueblos creeks would be largely avoided as a result of HDD beneath those creeks; however, trenching on the sidewalls of those canyons could similarly result in erosion induced sedimentation of the creeks. Similarly, EMT demolition and/or oil spill remediation activities would result in vegetation removal and excavations, which may cause an increased potential for short-term erosion and sedimentation of a nearby dune swale pond, a surrounding wetland, and Devereux Slough, located approximately 400 to 500 feet (121.9 to 152.4 m) southeast and topographically downgradient from the EMT and its associated marine loading line, at the closest point. Therefore, erosional impacts would be potentially significant (Class II), but can be mitigated to less than significant levels with implementation of **MM GEO-3a**.

Mitigation Measure

GEO-3a. Erosion Control Measures. Best Management Practices (BMPs) such as temporary berms and sedimentation traps, including silt fencing, straw bales, and sand bags, shall be installed prior to work involving ground

disturbance. The BMPs shall include maintenance and inspection of the berms and sedimentation traps during rainy and non-rain periods, as well as re-vegetation of impacted areas. Re-vegetation shall address plant type, as well as monitoring to ensure appropriate covering of exposed areas.

Rationale for Mitigation

MM GEO-3a would minimize erosion-induced sedimentation, caused by ground-disturbing activities, at nearby creeks, a dune swale pond, a wetland area, and Devereux Slough.

Impact GEO-4: Expansive Soils

Expansive soils along the proposed pipeline alignment could potentially affect the structural integrity of the pipeline (Potentially Significant, Class II).

Impact Discussion

Surficial soils (primarily overlying the Rincon Formation), from Eagle Canyon to the pipeline tie-in location west of Corral Canyon, are clay-rich and, therefore, have a moderate to high soil expansion potential. Expanding clays would create stress that could potentially affect the structural integrity of the proposed pipeline. Therefore, expansive soil impacts would be potentially significant (Class II), but can be mitigated to *less than significant* levels with implementation of **MM GEO-4**.

Mitigation Measure

GEO-4a. Expansive Soil Control Measures. Prior to pipeline construction, a geotechnical investigation shall be completed along the proposed pipeline alignment to determine the expansion potential of soils, to the depth of proposed excavations. The geotechnical investigation and associated recommendations shall be prepared by a licensed geotechnical engineer, subject to review and approval by the CSLC, to verify that soil expansion remedial measures comply with the existing geologic setting and current California Building Code (CBC) construction standards. Based on the results of the investigation, standard engineering construction-related soil expansion measures, such as pipeline trench backfilling with sandy, non-expansive soils, or a mixture of expansive material with non-expansive material, shall be implemented in the Project design as needed to minimize impacts associated with potentially expansive soils.

Rationale for Mitigation

MM GEO-4a would minimize potential pipeline structural integrity impacts due to expansive soils along the proposed pipeline alignment.

Impact GEO-5: Faulting and Seismicity

Seismic activity along the More Ranch Fault Zone or other regional faults could produce fault rupture, seismic ground shaking, liquefaction, or other seismically induced ground failure that would expose people and structures to greater than normal risk (Potentially Significant, Class II).

Impact Discussion

As illustrated by Figure 4.1-1a, the More Ranch Fault Zone traverses the eastern onshore Project area and possibly extends offshore across the pipeline/utility corridor from Platform Holly to the EOF. This fault zone consists of the South, Central, and Northern branches of the More Ranch Fault. The North Branch More Ranch Fault, which is considered active, was mapped approximately 0.5 mile (0.8 km) southeast of the EOF and proposed pipeline, at the closest point.

Strong-to-intense ground shaking due to an earthquake on these or other regional active faults could result in differential settlement, lateral spreading, and localized liquefaction, resulting in potential damage to and/or rupture of EOF infrastructure and associated pipelines. Earthquake-related hazards, such as liquefaction, ground rupture, ground acceleration, and ground shaking cannot be avoided in the Goleta/Gaviota region and in particular in the vicinity of the More Ranch Fault.

In addition to all other applicable Federal and State codes, regulations and industry standards for the pipeline design, CSLC requires that the pipeline design also meet the requirements of current seismic engineering standards such as the “Guidelines for the Design of Buried Steel Pipe,” 2001, by American Lifeline Alliance and “Guidelines for the Seismic Design and Assessment of Natural Gas and Liquid Hydrocarbon Pipelines,” 2004, by Pipeline Research Council International, Inc (PRCI) for seismic resistant design of the pipeline. CSLC also requires that all engineered structures, including pipeline alignment drawings, profile drawings, buildings and other structures, and other appurtenances and associated facilities, be designed, signed, and stamped by California registered professionals certified to perform such activities in their jurisdiction such as Civil, Structural, Geotechnical, Electrical and Mechanical Engineering.

The Santa Barbara County Energy Division maintains a Systems Safety and Reliability Review Committee (SSRRC) to identify and require correction of possible design and operational hazards for oil and gas projects. The goal of the SSRRC is to substantially reduce the risks of project-related hazards that may result in loss of life and injury and damage to property and the natural environment. The SSRRC is the delegated authority to review the technical design of facilities, as well as to review and approve the Safety, Inspection, Maintenance and Quality Assurance Program (SIMQAP) and its implementation, e.g., conduct safety audits, review facility changes, etc. (Santa Barbara County Energy Division 2005).

Seismic hazards are common to the Santa Barbara region and are not increased by the Project. However, because the offshore pipeline is potentially underlain by the active North Branch More Ranch Fault and the EOF and proposed pipeline are located 0.5 mile (0.8 km) northwest of this fault, there is a greater than average risk of seismic impacts. As stated earlier, in conjunction with the preparation of this EIR, an assessment of the existing drilling platform jacket structure is being performed, including a seismic analysis, with CSLC oversight. After CSLC acceptance of findings, retrofit upgrade of the platform structure, if required, would be designed and submitted to CSLC for approval. Therefore, seismic related impacts related to Platform Holly have not been discussed in this EIR.

Mitigation Measure

GEO-5a. Implementation of Site-Specific Geotechnical and Seismic Studies Results. The Applicant shall complete a site-specific geotechnical and seismic-hazard studies for the proposed pipelines routes including faulting, ground shaking, liquefaction hazards, landslides and slope stability issues. The Applicant shall submit certified copies of these reports to CSLC and SSRRC for review and approval. The Applicant shall implement all recommendations from the Geotechnical and Seismic studies as directed by CSLSC and SSRRC.

GEO-5b. Seismic Resistant Design. The Applicant shall perform seismic evaluation and design of the proposed pipelines and employ current industry seismic design guidelines including but not limited to: (a) "Guidelines for the Design of Buried Steel Pipe," 2001, by American Lifeline Alliance and (b) "Guidelines for the Seismic Design and "Assessment of Natural Gas and Liquid Hydrocarbon Pipelines," 2004, by Pipeline PRCI for seismic resistant design of the pipeline.

In addition, all engineered structures, including pipeline alignment and profile drawings, buildings, other structures, other appurtenances and associated facilities, shall be designed, signed, and stamped by California registered professionals certified to perform such activities in their jurisdiction such as Civil, Structural, Geotechnical, Electrical and Mechanical Engineering.

GEO-5c. Seismic Inspection. The operator shall cease Platform Holly, EOF and associated pipeline operations and inspect all project-related pipelines and storage tanks following any seismic event in the region (Santa Barbara county and offshore waters of the Santa Barbara Channel and Channel Islands) that exceeds a ground acceleration of 13 percent of gravity (0.13 g) based on a seismic accelerometer located at the EOF. The operator shall report the findings of such inspection to the CSLC, the city of Goleta, and the county of Santa Barbara. The operator shall not reinstate operations of Platform Holly and associated pipelines within the state tidelands until authorized by the CSLC. The operator shall not reinstate operations of the EOF and associated pipelines within the city of Goleta until authorized by the city of Goleta. The operator shall not reinstate operations of the pipelines and associated operations within the unincorporated areas of the county of Santa Barbara until authorized by the county of Santa Barbara.

Rationale for Mitigation

MM GEO-5a, MM GEO-5b and **MM GEO-5c** would reduce seismically induced impacts caused by a rupture on a nearby or regional fault by identifying failed components prior to resuming oil processing and transportation operations.

Impact GEO-6: Increased Natural Seepage

Increased natural oil and gas seepage could occur if produced water from the additional production is injected into formations that contribute to natural oil and gas seeps (Potentially Significant, Class II).

Impact Discussion

As discussed above, historically production from Platform Holly has produced a net outflow of fluids from the Monterey formation. This is due to the injection of produced water into the Vaqueros formation from the onshore injection well. However, with additional production from different formations, water injection could increase into the

Monterey formation, thereby producing a potential net inflow of fluids into the Monterey formation (or other seep producing formations), which could produce an increase in seep activity. The increase in seep activity could produce an increase in tar impacts at local beaches. This would be considered a significant impact.

Mitigation Measure

GEO-6a. Implementation of Reservoir Management Practices to Reduce Seepage. The Applicant shall implement reservoir management practices that minimize the injection of gas and fluids into seep forming formations. In particular, a net outflow of fluids shall be ensured from the Monterey formation to ensure seepage is not increased with additional production and injection practices.

Rationale for Mitigation

MM GEO-6a, would help to ensure that future reservoir management practices do not generate impacts caused by increased seepage in the Santa Barbara channel.

Table 4.1-2
Summary of Geological Resources Impacts and Mitigation Measures

Impact	Impact Class	Mitigation Measures
GEO-1: Slope Failures.	Class III	None required.
GEO-2: Damage to Facilities Due to Beach Scour.	Class II	See **MM HM-3b**
GEO-3: Erosion of Drainages.	Class II	**GEO-3a:** Erosion Control Measures.
GEO-4: Expansive Soils.	Class II	**GEO-4a:** Expansive Soil Control Measures.
GEO-5: Faulting and Seismicity.	Class II	**GEO-5a:** Implementation of Geotechnical and Seismic Studies Results. **GEO-5b:** Seismic Resistant Design. **GEO-5c:** Seismic Inspections.
GEO-6 Increased Seepage	Class II	**GEO-6a:** Reservoir Management Practices**.**

Extension of Life Impact

The Applicant has stated that the proposed Project would not increase the life of the existing South Ellwood Field Facilities, which is currently defined by the operational life of Platform Holly until 2040, and would likely reduce the overall duration of oil and gas production from existing facilities due to more efficient extraction of the resource. However, it is possible that increased oil and gas production from new wells drilled into

the existing and proposed leases, formations (Lower Sespe) and fault blocks (North Flank and Eagle Canyon) could produce economically viable resources for a longer-than-expected period and increase the life of the existing facilities. Therefore, the impacts identified in Table 4.1-1 have the potential to occur over a longer period than assumed for the proposed project, exacerbating potentially adverse impacts.

Increasing the project duration and exposure of facilities to potential geological hazards could result in an increased likelihood of an oil spill or other facility upset and would be considered potentially significant but mitigable (Class II).

4.1.5 Impacts of Alternatives

No Project Alternative

Under the No Project Alternative, current operations would continue, there would be no onshore pipeline or modifications to the EOF, and the EMT would not be decommissioned until the lease expires in 2013. Impacts would be less than those described for the proposed Project, as there would be no geologic impacts associated with pipeline construction. However, the existing facilities would similarly be subject to strong seismically induced ground failure and corrosion. In addition, the potential for pipeline failure associated with erosive beach scour would still exist.

Currently, lease agreements for the operations of the EMT are set to expire in 2013 and/or 2016 (see Section 2.0, Project Description). It is assumed that, under the No Project Alternative, after the lease expirations, the Applicant would pursue alternative means of crude oil transport such as pipeline or truck transportation. The impacts of these transportation modes are described in the Venoco Ellwood EMT Lease Renewal Project Draft EIR (CSLC 2007). Any future crude oil transportation options would be subject to appropriate agency review and approval.

No EOF Modifications

This alternative would include all of the components of the proposed Project except there would be no modifications to the EOF. Construction of the proposed pipeline would be the same as described for the proposed Project; however, minor grading and construction related impacts at the EOF would not occur, thus slightly reducing construction related erosional impacts. The EMT would be decommissioned as soon as the pipeline is operational. Under this alternative, impacts to geologic resources would be similar to the impacts associated with the proposed Project.

Processing on Platform Holly

Currently, processing of gas and crude oil is done on both Platform Holly and the EOF. Under this alternative, all of the EOF processing would be moved to Platform Holly. Most of the processing systems at the EOF would be removed, with power generation, crude storage, and pig processing elements remaining. Geologic impacts associated with construction of the pipeline and decommissioning of the EMT would be the same as the impacts for the proposed Project. Potential impacts to Bell Creek associated with construction activities within the EOF would be eliminated; however, excavations and grading associated with removal of oil processing equipment at the EOF could result in minor erosion induced sedimentation of Bell Creek. Operations within the EOF would be modified from current operation, but this change would not likely affect onshore water resources in the vicinity of the EOF. Therefore, under this alternative, impacts to geologic resources would generally be the same as the impacts for the proposed Project.

Las Flores Canyon Processing: Offshore Gas and Onshore Oil Pipeline Alternative

This alternative includes decommissioning of the EMT and abandonment of Line 96 as described in the proposed Project and would also include decommissioning of the EOF. Oil emulsion would be shipped through a new onshore pipeline (as described in the proposed Project) to the existing ExxonMobil LFC facility. Since this alternative includes construction of the onshore oil pipeline, geologic impacts associated with that component of this alternative would be the same as for the proposed Project. Similarly, potential erosional impacts to Devereux Creek and Devereux Slough would be as described for the proposed Project as a result of EMT decommissioning. Decommissioning of the EOF would result in minor, short-term, erosion-induced water quality impacts to Bell Creek, as a result of excavations and grading during infrastructure abandonment. Mitigation measure **GEO-3a** would apply for these temporary impacts (see page 4.1-23).

Las Flores Canyon Processing: Offshore Gas and Offshore Oil Pipeline

This alternative would be the same as the Processing at LFC: Offshore Gas and Onshore Oil Pipeline Alternative with the exception of a crude oil pipeline offshore to the existing ExxonMobil LFC facility instead of onshore. All impacts and mitigation measures would be the same, except that there would be no impacts associated with the onshore pipeline construction.

4.1.6 Cumulative Projects Impact Analysis

The proposed Project and several of the contemporary projects would involve repair and maintenance activities, which would require ground-disturbing activities that could result in erosion and possible sedimentation. Ground disturbance and potential erosion associated with the proposed Project would be localized and limited in scope. Potential erosional impacts during pipeline construction, due to sedimentation of Bell, Tecolote, Eagle, Dos Pueblos, Las Varas, Gato, Las Llagas, El Capitan, and Corral/Las Flores creeks, can be reduced to less than significant levels through implementation of standard erosion-control measures. Similarly, potential erosional impacts during EMT abandonment, due to sedimentation in the nearby dune swale pond and Devereux Slough, can be reduced to less than significant levels through implementation of standard erosion-control measures. Although ground disturbance associated with construction, demolition, or soil remediation may occur simultaneously with construction of other cumulative projects, implementation of standard erosion-control measures at each project site would similarly minimize cumulative erosion and sedimentation impacts to less than the significance criteria. See Section 4.4, Hydrology, Water Resources, and Water Quality, for additional information regarding other potential cumulative water quality impacts.

Structural development of individual projects is subject to code requirements of the CBC and would be completed in accordance with recommendations by a licensed geotechnical engineer and the Building and Safety Division, County Planning and Development Department. Therefore, geologic/seismic impacts associated with cumulative projects in the vicinity of the site would generally be site-specific and less than significant. Impacts to human health associated with potential large oil spills from the EOF and related pipelines are addressed in Section 4.2, Hazards and Hazardous Materials.

This page intentionally left blank.

List of Tables

List of Figures

Abbreviations

1